

DECam Prototype Observations for Calibration of the Dark Energy Survey

Kyler Kuehn, for the Dark Energy Survey Collaboration

The Era of Observational Cosmology

Recent observations paint a picture of the cosmos dominated by cold dark matter, augmented by the postulate that approximately 70% of the universe is composed of mysterious “**Dark Energy**” that drives the accelerated expansion of the universe.

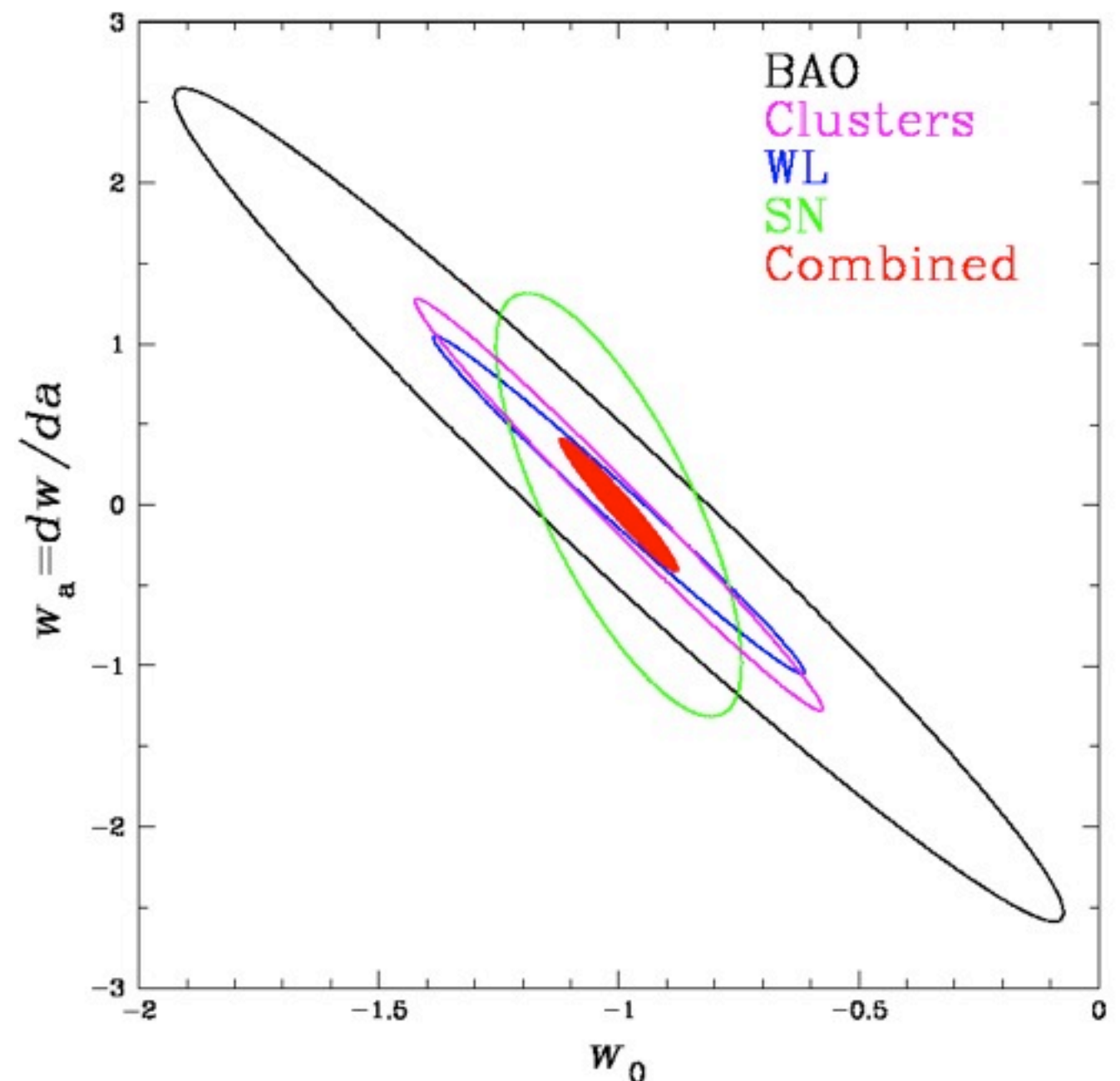
The properties of Dark Energy can be expressed in terms of the Equation of State at different redshifts:

$$w(z) = p/\rho$$

We parameterize $w(z)$ as follows:

$$w(z) = w_0 + w_a(1-a), \text{ where } a = (1+z)^{-1}$$

The Dark Energy Survey (**DES**) will repeatedly observe 5000 deg² of the southern sky, with the ultimate goal of measuring the expansion history of the Universe through the dependence on redshift of the luminosity distance, angular diameter distance, and volume element, along with the growth rate of structure. DES will significantly improve the precision of measurements of both w_a and w_0 (see Figure at right).

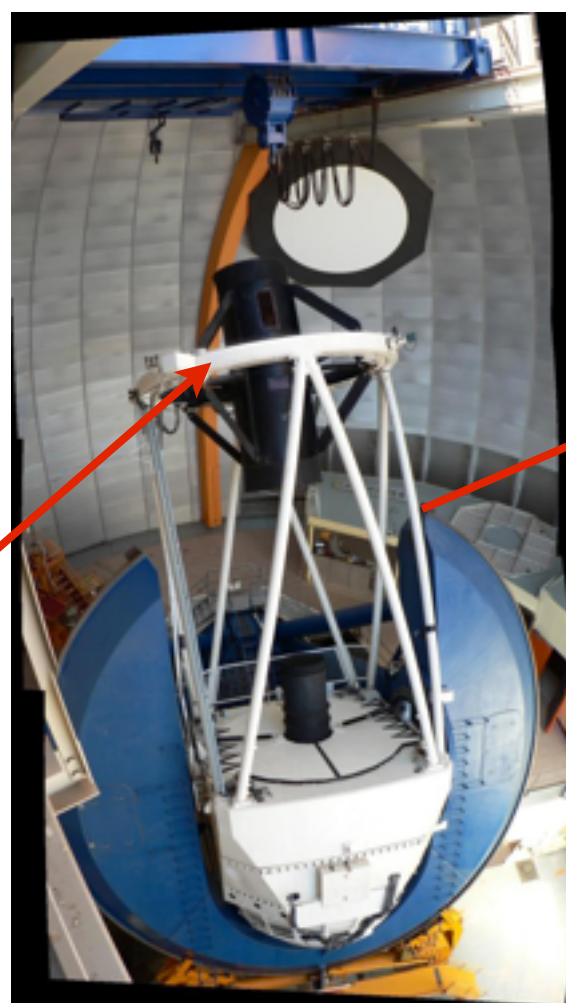
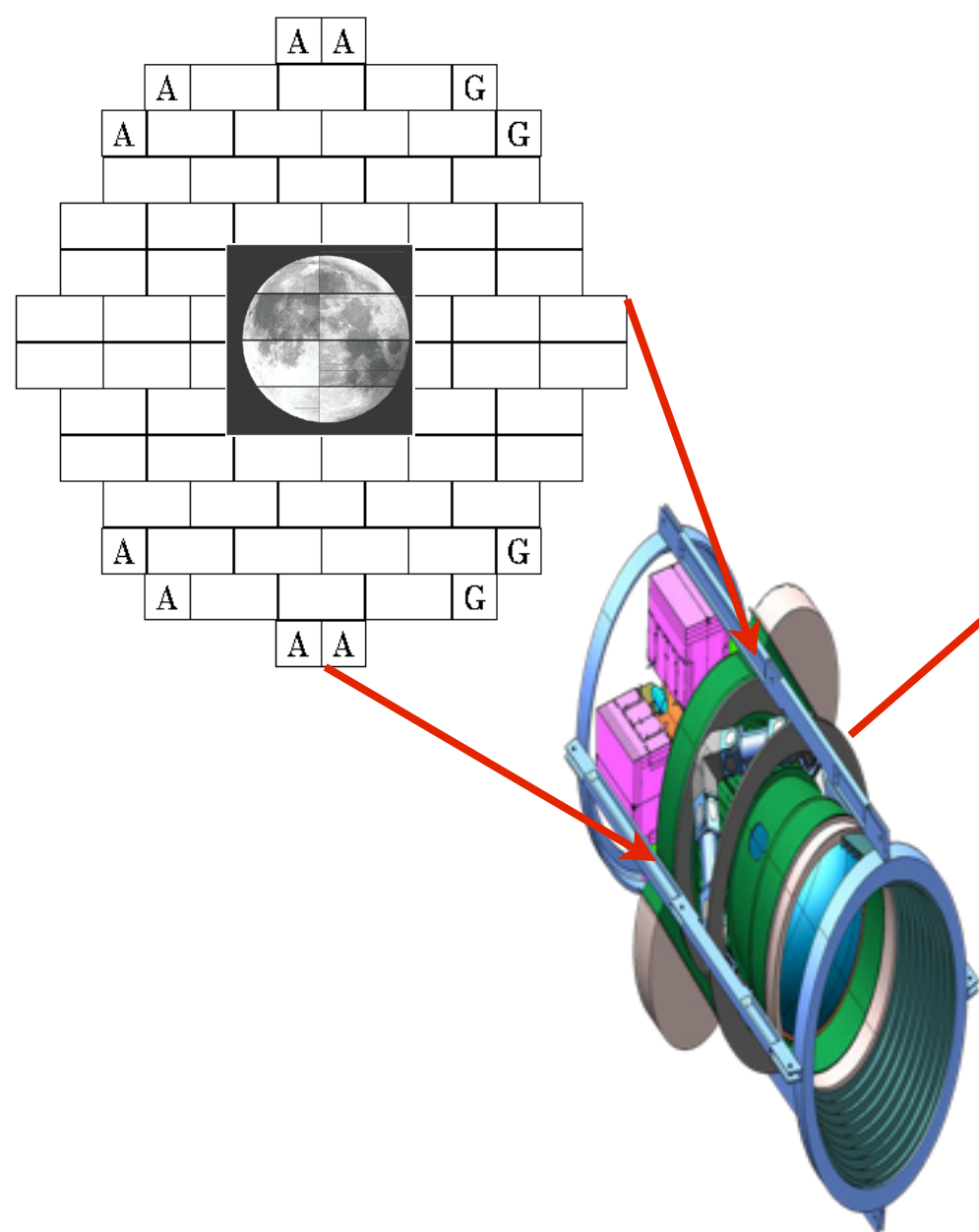


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The Dark Energy Camera

This survey will be undertaken by the newly-constructed Dark Energy Camera, which will be installed at the prime focus of the 4m. Blanco Telescope at Cerro Tololo Inter-American Observatory in Chile. DECam consist of 62 2k x 4k extremely red-sensitive ($QE > 50\%$ at 1000nm) CCDs, plus associated guide/focus CCDs, with a field of view of approximately 3 square degrees.



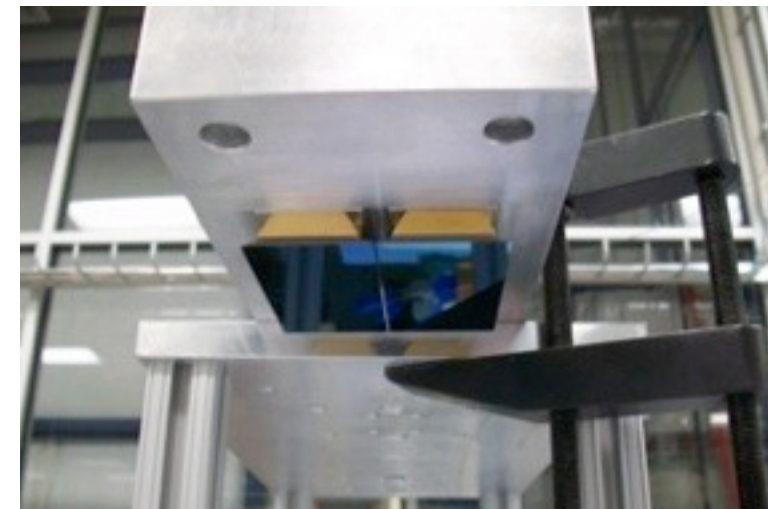
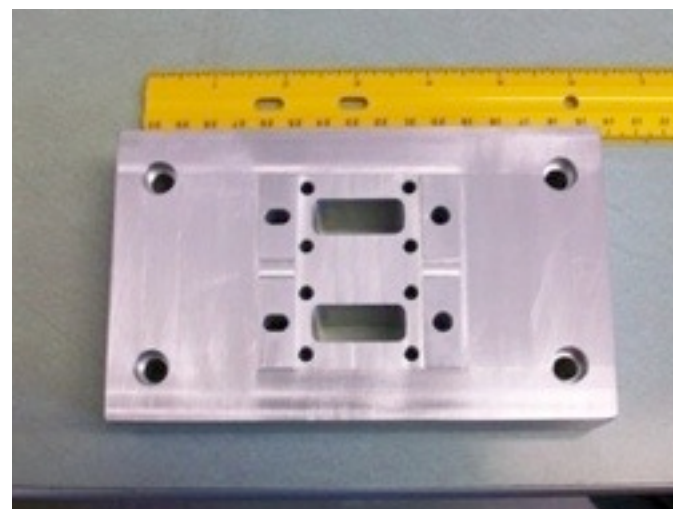
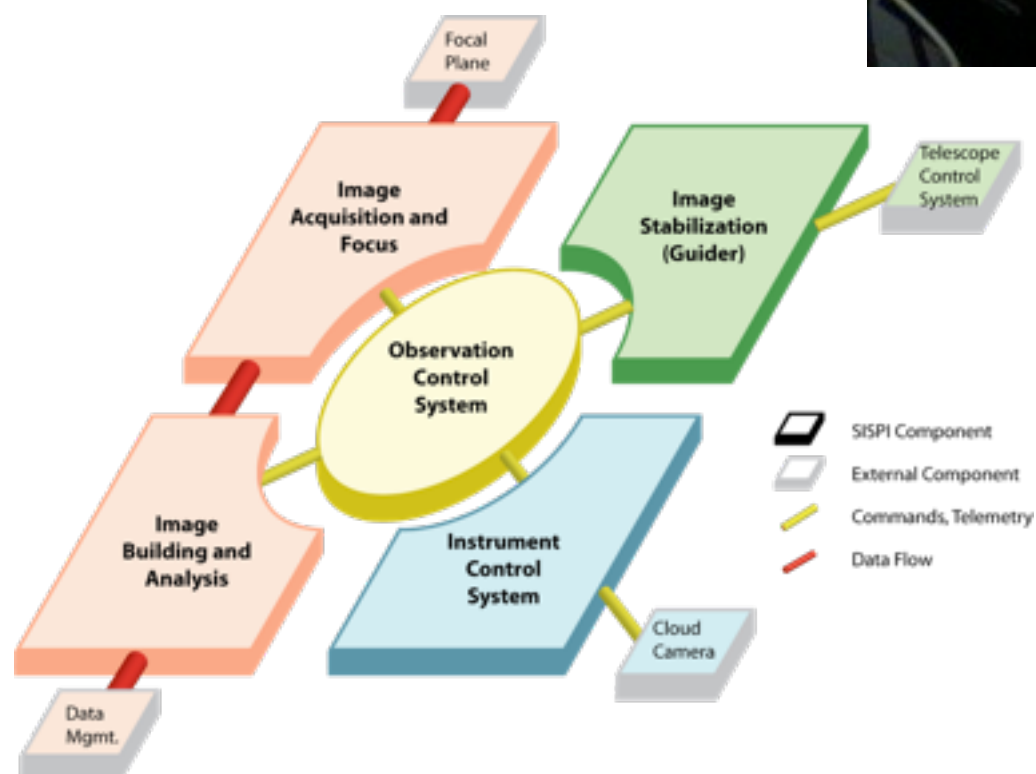
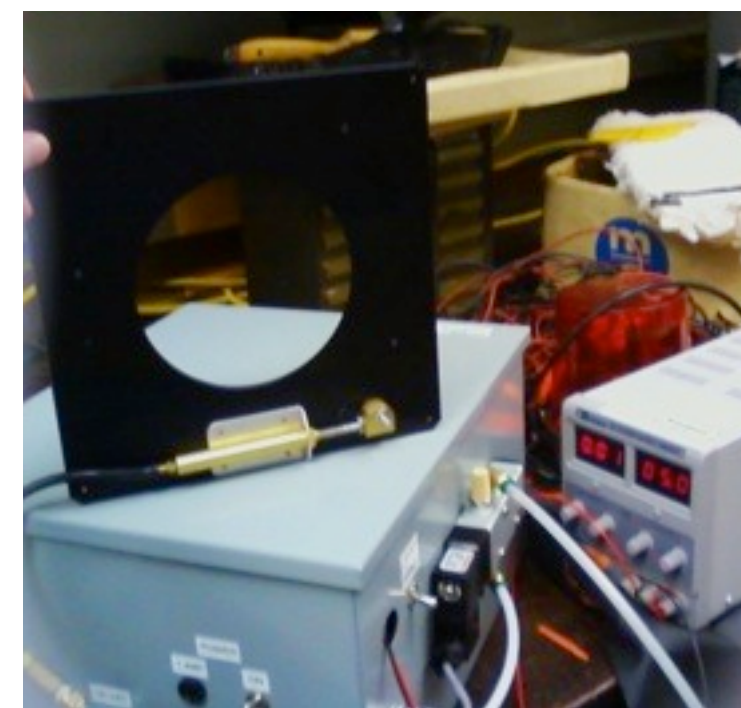
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PreCam: the Precursor to the Dark Energy Camera

PreCam consists of two 2k x 4k CCDs identical to those that will be used in the Dark Energy Survey, along with a pressure control system, cryogenics, and other hardware functionally similar to DES.

PreCam also provides a test of DES-style filters, readout electronics, and software infrastructure for instrument control and telemetry feedback.



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PreCam is scheduled for up to 100 nights, including installation and commissioning, on the Curtis-Schmidt (University of Michigan) Telescope at Cerro Tololo starting in **August 2010**.

PreCam's "Rib and Keel" observation strategy is expected save DES 10% of its survey time by providing calibration data for hundreds of stars per square degree in a sparse grid across the DES footprint. Table 1 describes the magnitude limits and exposure times planned for each PreCam passband.

Calibration data include extinction standards and nightly photometric solutions which will contribute to improving DES global relative calibrations from its 2% requirement to its 1% goal.

It will also contribute to SDSS-DES Transformations based on numerous observations of Stripe 82, and it will provide Y-band observations of standard stars, which are currently very sparse in the Southern Hemisphere.

Finally, it is expected to provide a bright star catalog for subsequent DES Image Quality tests as well as science data for bright objects in the DES footprint such as Milky Way red giants or local supernovae.

Table 1: Exposure Calculations for Point Sources in the Baseline PreCam Survey

Band	PreCam Exposure Time [seconds]	PreCam saturation limit	DES saturation limit (100s exposure)	PreCam mag limit (S/N=50)	PreCam detection limit (S/N=5)	# Stars per sq deg, DES sat to PreCam S/N=50
(1)	(2)	(3)	(4)	(5)	(6)	(7)
g	36	12.8	16.3	17.8	20.9	186
r	51	13.2	16.3	17.8	20.7	265
i	65	13.4	16.2	17.7	20.5	344
z	162	14.1	16.0	17.5	20.1	317
y	73	11.6	14.3	15.8	18.5	150

